



SnowNews

Summer 2017

Volume 6, Issue 2

Boise hosts 85th annual Western Snow Conference

[Jolyne Lea](#)

NWCC Forecast Hydrologist

The [85th annual Western Snow Conference](#) was held in conjunction with the Weather Modification Association in Boise, Idaho, April 17 – 20.

A short course titled “Tracing the Effects of Cloud Seeding through the Hydrologic Cycle” started off the joint conference with attendees learning about the processes, state and water reliant group programs, and discussions of ongoing research needs for current cloud seeding efforts.

The short course included presentations and a panel discussion by the National Center for Atmospheric Research (NCAR), Boise State University, Idaho Power, and Utah Department of Water Resources experts. The panel pointed out that not only does cloud seeding increase the snowfall from storms by up to 15%, it is used for enhancing rainfall and reducing the size of hail in warmer climates.

Following the short course, the conference was welcomed to Idaho by the **Honorable Butch Otter**, Governor of Idaho, who provided an Idaho perspective on the importance of water and snowpack. This was followed by additional welcoming remarks by **Darrel Anderson**, CEO of Idaho Power.

The keynote address on the importance of snow and water to the West was provided by **Jimmy Bramblett**, USDA NRCS Deputy Chief for Science and Technology.

General Chair and NRCS Water Supply Specialist from Washington, **Scott Pattee** then welcomed conference attendees on behalf of the Western Snow Conference and

the Conference Chair. Idaho NRCS Water Supply Specialist, **Ron Abramovich**, North Continental Chair and local host, welcomed everyone to Boise. **Tom Ryan**, President of the Water Modification Association provided the welcome to everyone from their organization.

continued on page 2

Inside this issue:

Solid state Master Stations up and running	3
Snow School 2017: The science of snow	4-6
SnowEx 2017	6
Field Operations Workshop	7
Spotlight on...Water and Climate Monitoring team	8
Cli-MATE new products	9
Julander receives lifetime achievement award	9
Featured photos	10
Resource locator	11
Upcoming events of interest	11
Director's Corner: Soil Moisture Networks	12



A sampling of presentations from the conference.



85th annual Western Snow Conference

cont'd from page 1

86th Western Snow
Conference

Albuquerque, NM

April 17– 20, 2018

Tuesday's technical paper presentations were broken into concurrent sessions for each area of interest. There was some cross-over of participants who were free to join each group and learn new information from each session.

Tuesday evening the Conference held their first-ever "Know your Snow" public forum at "Jack's Urban Meeting Place (JUMP)" with a panel of experts from local and conference attendees presenting snow information to the public, which was open for questions.

This was a well-received outreach for the public to learn about the different snow, cloud seeding, and winter recreation programs that were represented at the Conference.



Technical paper presentations at the conference were well-attended.

Annual technical tour

This year the technical tour focused on snow and water resource research in the Boise River Basin. Tour participants hiked to the Dry Creek Experimental Watershed research site to discuss instrumentation and research focus at Boise State University. They also visited a SNOTEL site at Bogus Basin, where some people new to snow surveys had a chance to manually measure the snowpack.

The day ended at the Bogus Basin Nordic Center where the group saw the [Bogus Basin SnowSchool](#) location which highlights activities for local school age children to learn about winter wildland and nature.

[Bogus Basin SnowSchool](#) is a national program for high school students

run by the Winter Wildlands Alliance where local groups set up educational opportunities that encourage kids to learn about snow and the natural environment in winter.

Conference proceedings will be available on the WSC website, or in print for members, in approximately six months.



Technical tour participants hiked to the Dry Creek Experimental Watershed Research site.



New solid state Master Stations up and running

After more than 30 years of near-continuous operation, the hardware and software at the two Snow Telemetry (SNOTEL) Master Stations in Boise, Idaho, and Dugway, Utah, have been completely upgraded.

Working closely with supplier Maiden Rock Communications, **Alex Rebentisch** and **John Weeks**, NWCC Electronics Maintenance Facility (EMF) Technicians, deployed the system components at the Boise Master Station in mid-May. Installation at the Dugway Mas-

ter Station occurred a few weeks later.

Comprised entirely of solid state components, the new system features a Meteor Burst Communications Terminal, a Remote Control and Monitor (RCAM) module, primary and backup power supplies and power amplifiers, a coaxial relay and an uninterruptible power supply.

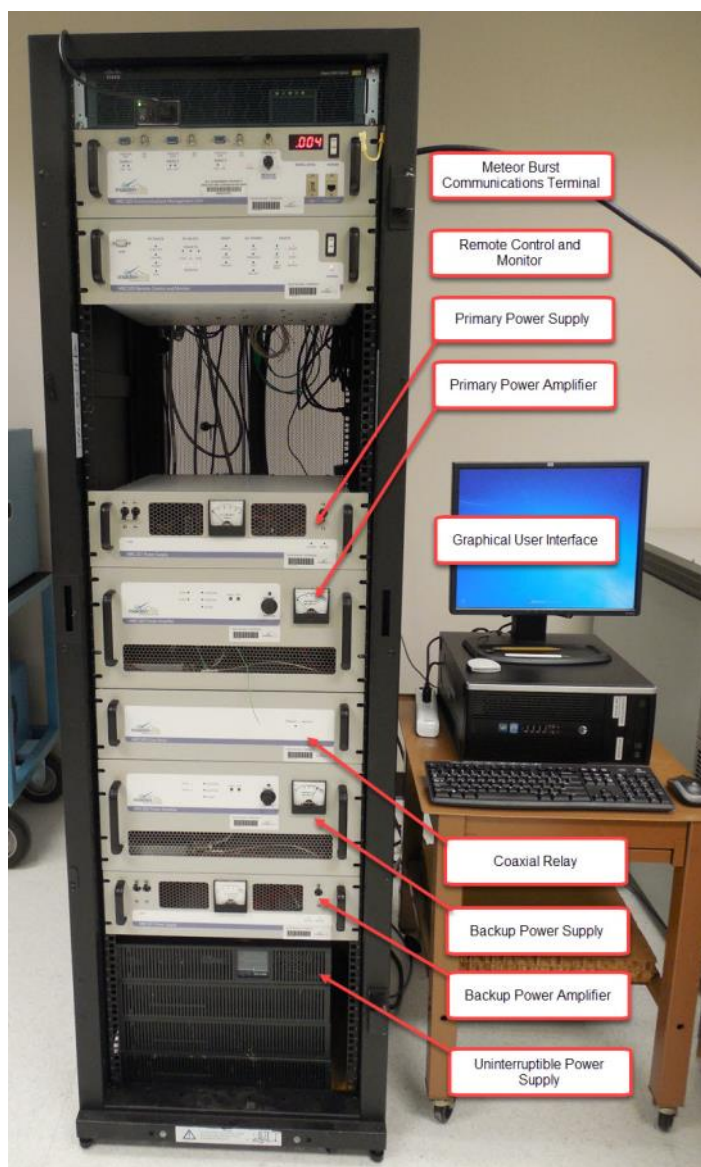
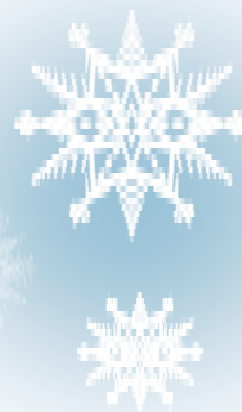
The new power amplifiers replace the bulky, tube-based amplifiers from the past. Current draw at 240V is 12A, which is about 25% of what the old equipment required.

rent draw at 240V is 12A, which is about 25% of what the old equipment required.

In addition, the RCAM module allows operators to monitor status of the Master Stations both locally and remotely.

Overall, the meteor burst Master Station system performance and reliability is expected to improve with the upgraded system components.

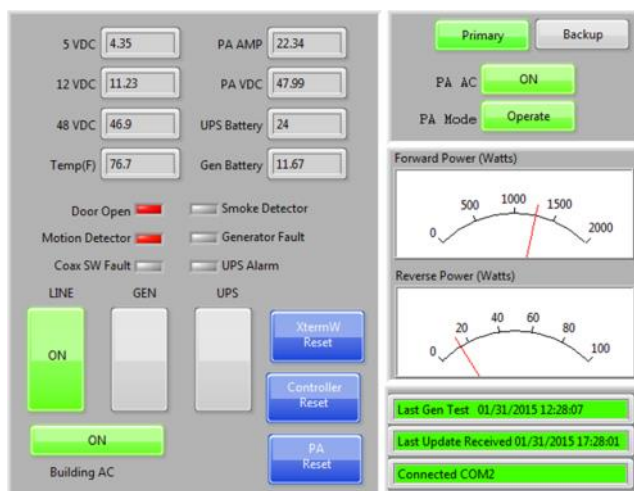
For more information, contact [John Weeks](#), 503-820-5740.



Components of the new solid state Master Station. The rack-mount design provides a much smaller footprint.



Legacy photo of original equipment in the Boise Master Station (circa 1978).



The Remote Control and Monitor (RCAM) graphical user interface allows operators to monitor the status of the Master Station components both locally and remotely.

Snow surveyors uncover the science of snowpack

Tracy Robillard
Public Affairs Specialist
NRCS Oregon

BEND, Oregon — If you want a history lesson about this season's snowpack, just grab a shovel and dig a pit.

That's what snow surveyors did at this year's USDA Westwide

Snow Survey Training to help them better understand science of snowpack.

As students dug through more than six feet of snow, instructors **Lucas Zukiewicz**, **Gus Goodbody** and **Karl Wetlaufer** showed them how to level off the pit wall and observe the various layers in the snowpack.

With each layer, students applied their newly-learned knowledge of snow science to speculate what kinds of storm conditions created the various layers and properties in the snowpack.

"Snowpack is very dynamic, and its properties are constantly changing due to large-scale scientific processes at play," said Zukiewicz, a water supply specialist for NRCS Montana. "Many variables govern these scientific processes, solar radiation, air temperature, wind, cloud cover, canopy cover, ground cover, and topography."

Understanding the relationship between these variables and the scientific processes they create can better help snow surveyors do their jobs.

"With even just a small lesson in snow science, we hope that snow surveyors can better anticipate snowpack conditions and potential hazards like avalanches before they venture outdoors to manually measure the snow," said Goodbody, a hydrologist with the NRCS National Water and Climate Center (NWCC) in Portland, Oregon.

About 40 snow surveyors from NRCS and other cooperating agencies gathered in central Oregon in January for this year's annual training.



Lucas Zukiewicz explains scientific processes within the snowpack to a group of students at the USDA Westwide Snow Survey Training in central Oregon, January 12, 2017. The students dug through more than six feet of snow to create a snow pit. NRCS photo by Tracy Robillard.

Snow surveyors uncover the science of snowpack

cont. from pg. 4



The week included lessons on snow sampling techniques, avalanche preparedness and rescue, survival training, first aid, snow mobile training, snow cave construction and new this year—snow science.

Students learned how most scientific processes in the snowpack are driven by temperature gradients, which is the difference between the ground and air temperature at the snow surface, and how water vapor moves through the snow.

“These processes are what form different layers in the snow, what change the structure of the snow and the snow grains,” Zukiewicz said.

For example, rounding in the snowpack is caused by a low temperature gradient between the air and the snow temperature. Snowflakes break down into a more rounded and spherical shape and can form a well-bonded layer.

Rounding is the most stable form of snowpack. It can also form a slab, though if the slab forms over a weak snow layer, it can

cause the potential for an avalanche.

Faceting—on the other hand—occurs when there’s a higher difference between the air temperature and the temperature of the snowpack, typically a difference above 10 degrees C.

Faceted snow grains are more angular instead of round. Because faceting involves a large air temperature gradient, it induces a large vapor pressure gradient that causes water vapor to move into the snowpack. The result is weak layers in the snow that can persist for a long time.

Faceting forms poorly-bonded, unstable snow. There are different types of faceting such as depth hoar, near-surface facets, and surface hoar.

With a general understanding of snow science, snow surveyors



Gus Goodbody inserts temperature gauges into the pit wall to observe temperature gradients at different levels in the snowpack. NRCS photo by Tracy Robillard.

can not only better anticipate snowpack conditions, but they can also develop a more intimate connection with their jobs.

“Our NRCS snow surveyors and our cooperating partners are out there on-the-ground measuring the snowpack in remote, mountainous areas,” Goodbody said.

“If we can help them see the bigger picture about what’s going on in the snowpack and the science that drives it, they fulfill a curiosity about the natural world and become more connected with their work.”

continued on page 6



As part of their lesson on snow science, students at the USDA West-wide Snow Survey Training dug through more than 6 feet of snow to create a snow pit. NRCS photo by Tracy Robillard.



More on the science of snowpack

cont. from page 5

NRCS is charged with forecasting streamflow and water supply throughout the West based on an extensive network of snow telemetry (SNOTEL) sites and manual snow course sites.

Since its inception in 1935, the USDA Snow Survey and Water Supply Forecasting (SSWSF) Program has grown into a network of more than 1,100 manually-measured snow courses and more than 850 automated SNOTEL stations across 13 Western states, including Alaska. The program provides streamflow forecasts at more than 650 stream gages in the West. Data from the automated snow sites are available near real-time through an extensive web delivery system.

The implications of snowpack accumulation across Western U.S. are huge. Snowpack and the resulting snowmelt drives

streamflow in rivers and streams. It fuels water supply for a variety of uses—irrigation and agricultural use, local city municipal use, hydropower and flood control use, fisheries management, and recreation.

View and download more photos from the 2017 West-wide Snow Survey Training on the NRCS Oregon Flickr page:

<https://flic.kr/s/aHskLJEPd5>



Lucas Zukiewicz explains how to assess layers in the snowpack from inside a snow pit at the USDA Westwide Snow Survey Training, Jan. 12, 2017. NRCS photo by Tracy Robillard.

Snow Survey members participate in SnowEx 2017



In February, NWCC forecast hydrologist **Gus Goodbody** spent a week in Silverton, Colorado participating in SnowEx 2017.

SnowEx is a NASA-led, multi-year research campaign to improve remote-sensing measurements of how much snow is on the ground at any given time and how much water is contained in that snow.

NASA's goal is to use the research to develop a multi-sensor satellite to study snow and predict water content.

Gus' field efforts were focused on mapping snow water equivalent (SWE) in Senator Beck

Basin (<http://www.snowstudies.org/sbbsa1.html>) near Red Mountain Pass, San Juan Mountains. He worked with nine other skilled snow scientists and alpinists from across the federal, academic and private sectors to ground-truth snowpack for validation and calibration of airborne sensors.

Concurrently, another field effort took place on the Grand Mesa, 100 miles to the north, where over 50 participants focused on similar ground-truthing in a much flatter study area. **Brian Domonkos** and **Lexi Landers** from the Colo-

rado Data Collection Office participated in this activity.

Aside from being an interesting project in its own right, the ability to interact with and support this group allows the NRCS Snow Survey and Water Supply Forecasting (SSWSF) Program to better understand the state of the technology for future snowpack monitoring, as well as influence the focus and direction of these projects to meet NRCS mission needs.

[SnowEx Program website](#)

Field Operations Workshop a major success

Snow Survey and Water Supply Forecasting (SSWSF) Program Electronics Technicians and field staff gathered in Bozeman, Montana April 10-14 for the annual Field Operations Workshop.

On the first day of the workshop, early arrivers were invited to an open house hosted by the Montana Data Collection Office.

On Tuesday, **Mike Strobel**, SSWSF Program Manager, welcomed attendees and provided an update on National Water and Climate Center (NWCC) activities, recent retirements, and new employees.

A representative from each state then gave 30-minute presentations on recent field and maintenance activities in their region.

Tuesday afternoon wrapped up with a video on the importance of flood forecasting and a report by **Lucas Zukiewicz**, Montana Data Collection Office (DCO), on the results of his work group's YSI temperature sensor testing.

Wednesday morning kicked off with **John Weeks**, Electronics Maintenance Facility (EMF) Lead Technician, discussing the current status of the Druck pressure transducer supply. **Alex Reben-tisch**, EMF Electronics Technician, followed with an open discussion on how to properly test and reinstall working pressure transducers.

Next, Alex discussed possible options for new, less expensive data loggers.

The status of the new Master Station hardware and software was next on the agenda. John explained the testing that the new equipment had undergone, the schedule for deployment, as well as some of the benefits of the new system.

Melissa Webb, Oregon DCO, then gave an update from the Telemetry Work Group. The group is currently comparing different telemetry methods, including a cost analysis of Iridium, GOES, cellular and meteor burst telemetries.

A group discussion followed about what each state planned to do with telemetry at their sites this summer.

The Wednesday afternoon training concentrated on snow scales. Alex gave an update on the Sommer snow scale installation at the Mt. Hood Test Site.

Amy Burke, Oregon DCO, provided an update on the Clackamas SNOTEL Sommer snow scale installation. **John Wilford**, Idaho DCO, Lucas Zukiewicz, and **Dan Kenney**, Alaska DCO, then provided details on the 2KR and Sommer snow scale installations in their states.

Wednesday's sessions concluded with **Bill Overman**, Oregon DCO, providing attendees a demonstration of deep snow measurement techniques.

The final day of the workshop focused on solar panels, regula-

tors, and batteries, led by John Weeks and Melissa Webb.

The do's and don'ts of site visits were next on the agenda. The group went over the standards and specifications for flora/fauna at SNOTEL sites and discussed dealing with flora-related site access issues.

Alex then presented techniques for meteorological tower cable shielding. Melissa followed up with a discussion on solar shading.

Deb Harms, Water and Climate Monitoring Team Lead, provided training on how to connect to a CR10X data logger through a cell modem using LoggerNet.

Lauren Austin, Oregon DCO, reported on cell modem performance at sites in her region.

A tour of the Montana Snow Survey shop was next for attendees, where they compared vehicle, tool, and equipment configurations.

The workshop concluded with training on GOES radio setup with Alex showing the group how to set up a GOES TX320 radio.



2017 Field Operations Workshop attendees travelled to Bozeman, Montana, for the 4-day training.



Spotlight on...Water and Climate Monitoring team

The NWCC Water and Climate Monitoring team supports the ongoing operation of both the Snow Telemetry (SNOTEL) system and the Soil Climate Analysis Network (SCAN).

Over the last year, the National Water and Climate Center (NWCC) Water and Climate Monitoring (WCM) team has welcomed three new employees.

In June 2016, **Alex Rebentisch** joined the team as an Electronics Technician, working with Lead Technician John Weeks at the Electronics Maintenance Facility (EMF) in Portland.

Alex is an Army Iraq War veteran. Through his service he was able to fund his education, graduating with an Associates Degree in 2013. Alex is also a certified Associate Electronics Technician through ETA International.

Before moving to Oregon, Alex worked for three and a half years at the Idaho Data Collection Office in Boise.

According to Alex, "My time involved with the many aspects of SNOTEL made me realize the importance of the work done in the snow survey program."

do Water Science Center in Pueblo, CO. Chris worked on regional aquifer quantity/quality monitoring programs, groundwater-surface water interactions, aquifer vulnerability studies, and geophysical hydrologic data collection techniques.

Even further back he worked in building materials testing in academic and private-sector labs in Missouri, crushing carbon fiber reinforced concrete panels and the like.

In his spare time Chris likes to ride bikes, brew beer, cook food, and eat food.

In Chris' words, "I'm very happy to be onboard at the NWCC and I look forward to meeting and working with all the talented folks in and around the NRCS."

Last to join the team in January was Statistical Assistant **Peter Briggs**. Peter joined the U.S. Coast Guard at the ripe age of 19 in Pearl Harbor, Hawaii. After graduation from boot camp he was assigned his first duty station at Coast Guard Station Portland, and loved it so much he hasn't left since.

During his time on active duty he was responsible for a wide range of activities including conducting search and rescue missions, providing homeland security, and enforcing federal laws to ensure ecological and environmental stewardship.

After the military

Peter studied accounting at the University of Portland and landed his first job as a financial analyst at the BPA under the SCEP program. He then transitioned to the VA and worked in their business office as a Budget Technician before making his way to the NRCS.

In Peter's words, "Working in many different capacities for the federal government has given me a huge sense of elation and reward from serving my community."

On the home front, Peter's family consists of his 10-year-old son, brother, girlfriend, and 3 lb. dog named Coco. Together they all like to do many family activities such as trips to OMSI, rock hounding, and four-wheeling on the sand dunes.

Please welcome Alex, Chris, and Peter to NRCS!



Alex Rebentisch at the EMF shop.



Chris Brown snapped this photo at the top of Bishop's Castle in the Wet Mountains of Colorado.

Next to join the WCM team was Hydrologist **Chris Brown**. Before moving to Portland, Chris worked for the Forest Service in Denver, CO/Grand Lake, CO as a Hydrologist with the Arapaho-Roosevelt National Forest. While there he worked on lacustrine water quality issues and NEPA documentation.

Most of Chris' career with the federal government has been spent as a Hydrologist with the USGS in the Arizona Water Science Center in Flagstaff, AZ and then the Colora-



Passing the baton...Peter Briggs with now-retired Statistical Assistant Denice Schilling. In March, Peter spent time cross-training with Denice in Bozeman, MT.

cli-MATE application adds two new products

The Midwestern Regional Climate Center (MRCC) cli-MATE application recently added two new products to its suite.

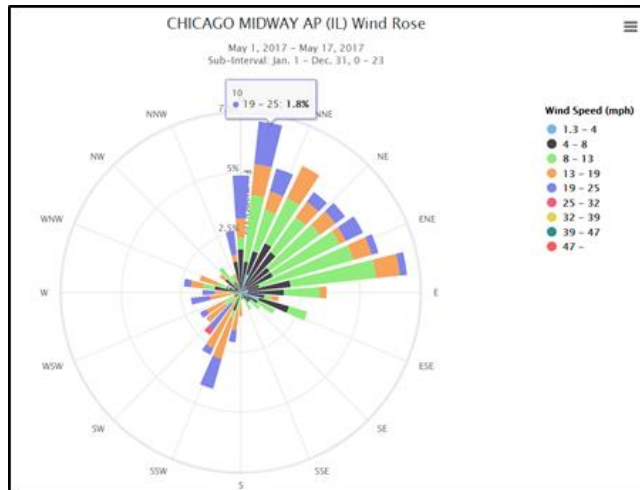
The [cli-MATE Wind Rose tool](#) allows registered users to select any timeframe during a station's period of record to analyze wind speed and direction including filtering by specific dates or times of day. The tool offers many output formats, such as the units of the wind speed and how many compass points to display on the wind rose.

To access the tool, login to cli-MATE and select Hourly-Observed Data > Wind Rose.

Hourly-Observed Data	Hourly Data Lister
Climate Division Data	Wind Rose
State Data	Daily-Averaged Hourly Data
Maps of Data	Multi-Station Daily Averages
Charts and Graphs	Metar - Raw or Decoded
Help	CRN Data

The [cli-MATE Bi-National Precipitation tool](#) lets registered users map the Canadian Precipitation Analysis (CaPA) data, Multi-sensor Precipitation Estimates (MPE) data, or data created by the MRCC that merges the CaPA and MPE.

Maps may be generated for either the Great Lakes region or most of North America.



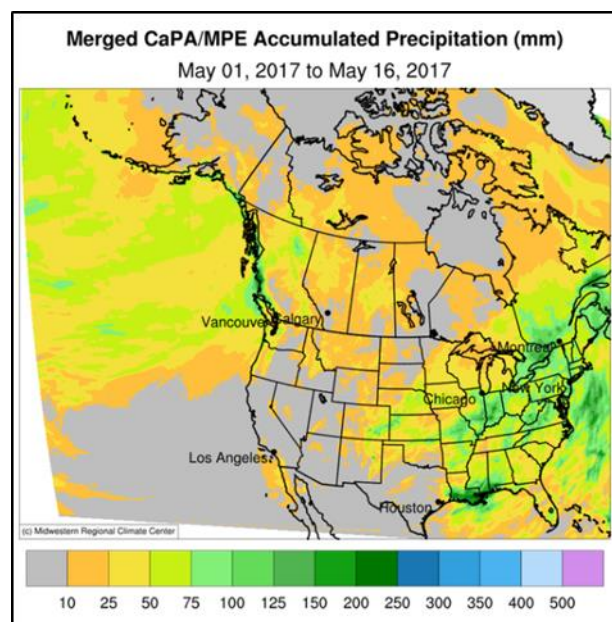
Wind rose plot for Chicago Midway Airport.

Data are currently available from 2010 through the present, but will soon go back to 2002 when both the CaPA and MPE started. All measurements are in millimeters.

To access this tool, login to cli-MATE and select Maps of Data > Bi-National Precipitation.

Maps of Data	MRCC Gridded Data
Charts and Graphs	Interpolated Station Data
Help	Bi-National Precipitation

Merged precipitation data for North America.



Julander recognized by Utah water resources group

The Utah section of the American Water Resources Association (AWRA) recently honored **Randy Julander**, Utah Snow Survey Supervisor, with a lifetime achievement award.

The award reads "American Water Resources Association Utah Section Recognizes Randall P. Julander for Outstanding Service in the Public

and Academic Sectors of Utah's Water Resources Community. May 16, 2017"

Congratulations, Randy!

Randy with his lifetime achievement award from the AWRA (left) and a previous El Farsante award from the Western Snow Conference (right).



Featured Photos



2016-2017 was a record-setting snow season in Nevada as evidenced by the photo above. In the photo, taken by the **Nevada Department of Transportation** in January, rotary plows attempt to clear snow on Slide Mountain Road.

Not to be outdone, Wyoming also recorded impressive snowpacks this season. The photo at left was provided by **Ken VonBuettner** from the Wyoming Snow Survey. Here, a marker at the Blue Ridge snow course is completely obstructed by the snowpack.



With snow season over, **Katie Cerretani**, Special Assistant to the Deputy Chief of SSRA (second from left) recently visited the Clear Lake SNOTEL site with **Deb Harms**, WCM Team Lead, **Lauren Austin** and **Scott Oviatt**, Oregon DCO. Photo by **Mike Strobel**.

Snow Survey and Water Supply Forecasting Program

Resource Locator

Here's a handy reference for finding resources in the Snow Survey and Water Supply Forecasting Program.

Where	What	Who	How
Alaska	Forecast Hydrologist	Jolyne Lea 503-414-3040	jolyne.lea@por.usda.gov
	Data Collection Office Supervisor	Daniel Fisher 907-671-7746	daniel.fisher@ak.usda.gov
Arizona	Forecast Hydrologist	Jolyne Lea 503-414-3040	jolyne.lea@por.usda.gov
	Water Supply Specialist	Dino De Simone 602-280-8786	dino.desimone@az.usda.gov
California	Forecast Hydrologist	Jolyne Lea 503-414-3040	jolyne.lea@por.usda.gov
	Water Supply Specialist	Greg Norris 530-792-5609	greg.norris@ca.usda.gov
Colorado	Forecast Hydrologist	Cara McCarthy 503-414-3088	cara.s.mccarthy@por.usda.gov
	Hydrologist	Karl Wetlaufer 720-544-2853	karl.wetlaufer@co.usda.gov
	Data Collection Office Supervisor	Brian Domonkos 720-544-2852	brian.domonkos@co.usda.gov
Idaho	Data Collection Officer (acting)	Dan Tappa 208-378-5740	daniel.tappa@id.usda.gov
	Forecast Hydrologist	Rashawn Tama 503-414-3010	rashawn.tama@por.usda.gov
	Water Supply Specialist	Ron Abramovich 208-378-5741	ron.abramovich@id.usda.gov
Montana	Data Collection Office Supervisor	Mage Hultstrand 406-587-6844	mage.hultstrand@mt.usda.gov
	Forecast Hydrologist	Cara McCarthy 503-414-3088	cara.s.mccarthy@por.usda.gov
	Water Supply Specialist	Lucas Zukiewicz 406-587-6843	lucas.zukiewicz@mt.usda.gov
Nevada	Forecast Hydrologist	Jolyne Lea 503-414-3040	jolyne.lea@por.usda.gov
	Water Supply Specialist	Jeff Anderson 775-857-8500 x152	jeff.anderson@nv.usda.gov
New Mexico	Forecast Hydrologist	Gus Goodbody 503-414-3033	angus.goodbody@por.usda.gov
	Water Supply Specialist	Chris Romero 520-292-2999 x107	chris.romero@nm.usda.gov
Oregon	Forecast Hydrologist	David Garen 503-414-3021	david.garen@por.usda.gov
	Hydrologist	Melissa Webb 503-414-3270	melissa.webb@or.usda.gov
	Data Collection Office Supervisor	Scott Oviatt 503-414-3271	scott.oviat@or.usda.gov
Utah	Forecast Hydrologist	Gus Goodbody 503-414-3033	angus.goodbody@por.usda.gov
	Snow Survey Supervisor	Randy Julander 801-524-5213	randy.julander@ut.usda.gov
Washington	Forecast Hydrologist	Gus Goodbody 503-414-3033	angus.goodbody@por.usda.gov
	Water Supply Specialist	Scott Pattee 360-428-7684	scott.pattee@wa.usda.gov
Wyoming	Forecast Hydrologist	Cara McCarthy 503-414-3088	cara.s.mccarthy@por.usda.gov
	Water Supply Specialist	Lee Hackleman 307-233-6744	lee.hackleman@wy.usda.gov
All States	Center Director/Program Manager	Mike Strobel 503-414-3055	michael.strobel@por.usda.gov
	Information Systems Team Lead (acting)	Rashawn Tama 503-414-3010	rashawn.tama@por.usda.gov
	Water & Climate Monitoring Team Lead (acting)	Deb Harms 503-414-3050	deb.harms@por.usda.gov
	Water & Climate Services Team Lead	Cara McCarthy 503-414-3088	cara.s.mccarthy@por.usda.gov
	Database Manager	Maggie Dunklee 503-414-3049	maggie.dunklee@por.usda.gov
	Database Manager	Vacant	
	Hydrologist (Water & Climate Monitoring)	Chris Brown 503-414-3090	chris.r.brown@por.usda.gov
	Development Hydrologist	David Garen 503-414-3021	david.garen@por.usda.gov
	Operations Specialist (SNOTEL/SCAN)	Vacant	
	Resource Conservationist	Vacant	
	Statistical Assistant/SCAN QC	Peter Briggs 503-414-3061	peter.briggs@por.usda.gov

Contact Help Center

There's an online tool to help locate resources within the Snow Survey and Water Supply Forecasting Program.

Click [here](#) to open the **Contact Help Center**. Don't forget to bookmark the url.

Upcoming events

Events of interest in the coming months.



What: American Association of State Climatologists Annual Meeting

When: June 28-30, 2017

Where: Asheville, NC

More information:
[Conference Overview](#)

What: 8th Annual Northwest Climate Conference

When: October 10-11, 2017

Where: Tacoma, WA

Call for Abstracts
More information:
[Laura Whitely Binder](#)

What: 4th World Conference on Climate Change

When: October 19-21, 2017

Where: Rome, Italy
More information:
[Conference Overview](#)

What: American Meteorological Society 98th Annual Meeting

When: January 7-11, 2018

Where: Austin, TX
More information:
[Meeting Overview](#)

What: 86th Annual Western Snow Conference

When: April 17-20, 2018

Where: Albuquerque, NM
More information:
[Conference Overview](#)



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For issues of **SnowNews** go to:
www.wcc.nrcs.usda.gov/SnowNews/
[SnowNews landing.htm](#)

Our mission is: *"To lead the development and transfer of water and climate information and technology which support natural resource conservation."*



With a vision of the future as:

"A globally-recognized source for a top quality spatial snow, water, climate, and hydrologic network of information and technology."

Director's Corner: Soil Moisture Networks



I just returned from a workshop held in Stillwater, Oklahoma, where there were many fantastic presentations and student posters focused on recent research in the collection, analysis and modeling of soil moisture data. With concerns about drought, climate variability, precision agriculture, flood forecasting, and water scarcity, soil moisture is certainly a key parameter in our understanding of local, regional and global hydrology.

So much is being done to improve our quantification of soil moisture. Cosmic-ray neutron sensors allow for a broad footprint of accurate soil moisture assessment. Satellite data from sources like [SMAP](#) give us a wide swath of information with each orbital pass. Modeling efforts, such as [NLDAS2](#), take a

multi-model approach and help provide more spatial, depth and temporal estimations of soil moisture.

One area we are data-rich in is in situ soil moisture data collection. There are many states that operate their own mesonets and collect soil moisture at various depths and time series. These in situ networks are growing rapidly and not only are used locally for providing information on soil moisture, but also are critical for model and remote sensing calibration.

We are also seeing an increase in citizen science as it relates to soil moisture. [CoCoRAHS](#) has initiated the collection of soil moisture at a number of locations to complement their private citizen weather observations. They have found a strong interest from the public in wanting to be involved with soil moisture observations.

There are two national in situ networks that operate in near-real time; the U.S. Climate Reference Network ([USCRN](#)), operated by NOAA, and the Soil Climate Analysis Network ([SCAN](#)), operated by NRCS. At present, USCRN consists of 134 stations; 118 in the contiguous U.S., 18 in Alaska and 2 in Hawaii. SCAN operates 221

stations; 190 in the contiguous U.S., 14 in Alaska, 8 in Hawaii, 8 in Puerto Rico and 1 in the Virgin Islands. Although both are national networks, there remains large areas of the country that lack coverage.

The largest in situ network for soil moisture in the U.S. is the Snow Telemetry ([SNOTEL](#)) network operated by NRCS in the western U.S. This network has soil moisture sensors at 441 SNOTEL sites, as well as 2 SNOLITE stations. The majority of these stations are in the 11 contiguous states in the West and 25 stations are in Alaska.

Within NRCS it is the intention of the Snow Survey and Water Supply Forecasting Program to continue to expand the soil moisture network at SNOTEL stations each year and develop methodology to incorporate soil moisture into water supply forecasting modeling efforts. Better understanding and quantification of soil moisture should enable hydrologists to improve the skill of water supply forecasts, and thereby, better serve our customers, the American people.

Mike



USDA NRCS is an equal opportunity employer and provider